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(21) (A1) 2,048,182
(22) 1991/07/31
(43) 1992/02/01

(51) INTL.CL.[5] B07B-013/00; B07B-015/00

(19)(CA) APPLICATION FOR CANADIAN PATENT (12)

(54) Procedure for Separation of a Flow of Heterogeneous Materials Into Two Flows with Different Physical Characteristics, Particularly Suitable for Treating Solid Municipal, Commercial and/or Industrial Wastes, and Machine for Its Application

(72) Cerroni, Manlio - U.S.A. ;

(73) Sorain Cecchini Recovery, Inc. - U.S.A. ;

(30) (IT) 48196 A/90 1990/07/31

(57) 7 Claims

ABSTRACT

The flow of material to be treated undergoes three successive phases of treatment:

a "launch" phase, with a cosequent impact against a wall, during wich the dynamics of impact differ according tc the rigidity of the material; a second phase in which an appropriately regulated current of air passes across the trajectory of fall; and a third phase in which, by means of an inclined plane moving in a predetermined direction, the material falling from above it in the aforesaid different trajectories acquires, in part through friction, different speeds and directions of motion.

The mchine for implementation of the above procedure has : a device (3) to launch the flow of arriving material to be separated; a wall (4), variabmy inclinable, against wicb the material launched by device (3) strikes; an outlet (7) for a flow of air that invests the material (3) after its impact against wall (4); an inclinable plane (10), with the possibility of varying the angle of inclination and the velocity

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Procedure for separation of a flow of heterogeneous materials into two flows with different physical characteristics, particularly suitable for treating solid municipal, commercial and/or industrial wastes, and machine for its application.

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It is well known that solid municipal, commercial and industrial wastes contain large amounts of paper of every kind, cardboard, plastics rigid and in films, glass, organic material and so on, whereas the various metals are only present in very small quantities, including aluminium which is mainly in the form of drinks cans.

The organic material, which creates considerable problems in tips because of the quantity of percolate it generates, can usefully be transformed into a product suitable for improvement of farm land which goes under the name of "compost". The composting procedures are known, but there are current laws which strictly and precisely limit the permitted contents of compost, particularly in relation to inert materials and heavy metals. These last derive

from solid contaminants present in the organic material such as various metals, batteries and glass with a high lead content which migrate into the final product during the biological composting process, contaminating it.

Aluminium, especially in the form of drinks cans, is a particularly valuable material in particular market demand because of its high energy value in relation to bauxite; its recovery is based on known mechanized systems that use magnetic fields generated by induced currents which repel conducting materials that pass through these fields. Rational use of this method, however, requires that the volume of aluminium be significant in relation to that of the rest of the refuse, so that the latter does not obstruct its expulsion.

The presently practised division by size into flows of the solid wastes to be treated does not solve the problem, given that a size grade may be such as not to contain used aluminium cans, together with many other materials, so that one has to use several successive separation treatments to obtain the necessary percentage volume of aluminium.

A need was therefore felt for a procedure for dividing heterogeneous material that would be simple, effective and low in both capital and running costs, so as to permit quick and certain separation of the material being treated.

One object of the present invention is a procedure for separating a flow of heterogeneous materials into two flows with different physical characteristics, particularly suitable for separating solid municipal, commercial and/or industrial wastes.

Another object of the present invention is a machine for application of the procedure of which above.

According to the procedure in question, a flow of heterogeneous material, particularly a flow of solid municipal refuse, is divided into at least two flows of which one substantially contains soft material, such as organic materials and the like, while the other contains rigid materials such as aluminium containers, metallic materials, hard plastics and the like.

The procedure according to the invention consists substantially in imparting a certain

quantity of kinetic energy to a flow of heterogeneous material, in making the material thus accelerated hit a surface - the dynamics of the impact varying according to the rigidity of the material - in investing the material with a current of air in its fall following the impact with the wall, and finally in making the material thus divided fall onto a moving inclined plane where, in addition to the impact, the force of friction and the component of velocity are exploited, which is opposite to that of the motion of the material and more sensitive for rigid bodies and almost nil for soft bodies.

In other words, according to the invention the flow of material to separate undergoes three successive phases of treatment.

A first "launch" phase, with a consequent impact against a wall, during which the dynamics of impact differ according to the rigidity of the material, giving rise to different trajectories of fall which create differences in the points of fall of the different materials and in their velocities of fall.

A second phase in which an appropriately regulated current of air passes across the trajectory

of fall in starting from the rigid and towards the soft material, in order to increase the difference between the trajectories of fall for the two types of materials.

A third phase in which, by means of an inclined plane moving in a predetermined direction, the material falling from above it in the aforesaid different trajectories acquires, in part through friction, different speeds and directions of motion, being definitively separated into two perfectly distinct flows nearly free of mutual contamination.

As indicated, another object of the invention is a machine to implement the procedure of which above.

According to the invention, the machine includes a device for launching the flow of arriving material, a wall of variable angle against which the material to be separated according to its physical characteristics of rigidity strikes, a source of an air current which invests the flow of material during its fall after impact with the aforesaid wall, a conveyor moving in the same direction as the current of air on which the material falling after its impact with the wall falls in a fan, and devices to increase

separation making use of the different friction forces of the various materials making up the flow and the aforesaid specific physical characteristics.

The invention will be better understood and other particulars will appear from reading the description which follows, prepared with reference to the attached drawings in which:

Figure 1 illustrates the machine in outline, in elevation and cross section;

Figures 2 and 3 show the forces acting on the materials by virtue of their different trajectories according to the angle of inclination of the final conveyor.

With reference to the said drawing and in particular to figure 1, a machine for implementation of the procedure of which above comprises substantially:

A throw belt 3, or another suitable device, which receives, for example from a conveyor belt 1, the material 2 to which a velocity and hence a kinetic force must be imparted;

A wall 4, variably inclinable for the reason which will be explained below, against which the

material launched by means 3 impacts:

an outlet 7 for a flow of air that invests the material 3 along its fall trajectory after its impact against wall 4;

an inclinable plane 10, preferably a conveyor belt, which perfects separation of the falling materials into two clearly distinct flows, one formed of soft materials 15 and one formed of rigid materials 13.

Specifically, as indicated, while the accelerator device 3 can be varied in velocity, thus varying the kinetic energy of the material 2, the wall 4, against which the material strikes after its launch, can be set at different angles to the vertical and at the same time its distance from device 3 can be varied. The best bounce effect is thus obtained and therefore the best trajectories desired. To this end the casing 5 which houses the accelerator device 3 and the wall 4 can be moved in relation to casing 6 which houses the remaining devices. By this simple device one regulates the point of impact of the materials which, after impact with inclined plane 10, follow their different

trajectories in accordance with their characteristics of softness and rigidity.

Naturally, the kinetic energy imparted to the material 2 by device 3 is transformed at the moment on impact with wall 4 into energy of elastic deformation and energy of plastic deformation. The rigid materials suffer only moderate plastic deformation and acquire the greater part of the energy they possessed before the impact in the form of elastic energy, bouncing back, whereas the soft materials lose almost all the energy they had, which is transformed into energy of deformation, and therefore they do not bounce and follow different trajectories.

It follows that the trajectories followed by the various components of the material treated form a kind of upside down fan with its apex at the point of impact with the surface 4 and widening downwards.

As already indicated, the machine provides for an inlet 7 for a current of air to increase the difference between the trajectories of components. This current of air invests, essentially at right angles, the various trajectories of the material 2 as

it falls after impact and before it reaches the inclined plane 10.

Before exiting through the outlet 9, the air is filtered through a rotary cage filter 8 with a self-cleaning counter-pressure device.

The quantity of air passing through the machine may be variable and in any case the equilibrium is such that there is always a negative pressure inside the machine, so that no air escapes through the outlets for the soft material 16 and for the rigid material 14. To this end, as indicated with Q, the quantity of air blown through inlet 7 and that aspirated through outlet 9 must be $Q2 = Q1 + X$, in which X indicates the air entering the machine through outlets 14 and 16 and the material inlet 2. All escape of air is prevented in this way, but one also checks the air drawn in through the various apertures in the machine.

The machine is also provided with an inclined plane 10, as already indicated, which completes the division of the material into two clearly separate flows, one formed of soft components and the other of rigid components, avoiding intermediate flows with no

clearly defined characteristics. The inclined plane 10 is formed of an inclined conveyor belt, with a possibility of varying the angle of inclination and velocity.

As can be seen in the drawing, the powered roller of the belt is large in diameter, while the idler roller 12 is of ordinary size. It is therefore possible to vary the angle of the inclined plane according to the material treated or the separation one wants to obtain. The shape that the inclined plane 10 takes at the powered roller 11 is specifically to be noted. At this point, in fact, the plane 10, wrapping around drum 11, progressively decreases its angle to the horizontal until it becomes nil.

As can be seen from the drawing, moving casing 5 in relation to casing 6, independently of the angle of inclination of wall 4, and in relation to the current of air flowing from inlet 7, the points of fall of the material are moved along plane 10, away from the roller (figure 2) or nearer it (figure 3).

Specifically, with reference to figure 2, looking at the two extreme trajectories indicated as

17 and 18 of the fall fan, it is easy to see how trajectory 17, corresponding to the rigid material, has an angle of incidence of 19° with the inclined plane 10, distinctly less than the angle of incidence 20 corresponding to the trajectory 18 of the soft material. Since the velocities of the materials following the two trajectories are different and velocity V1 is certainly higher than velocity V2 as a result of the kinetic energy returned to the rigid bodies, one can easily see, partitioning the velocities, that the components of the velocities in the direction of the inclined plane 10 are different for the two types of material. These velocity, indicated as V15 and V25 in the diagram, are those which, at the moment of impact on the plane, oppose those of the plane itself, giving rise to the desired separation into two flows, one of which containing the rigid materials will fall in the direction of V15 opposite to V, while the other, containing the soft materials, will follow the direction V, opposite to the direction of V15.

A significant contribution to increasing this differentiation is made by the coefficient of

friction of each component of the material with the surface of the plane 10. It is easily understood that the soft material, given its plastic deformability, adheres better than the rigid material to the surface of the plane 10 and therefore has a stronger force of friction which tends to draw it in the direction of the velocity V of the inclined plane 10.

If the material is made to fall in the zone in which, by virtue of the curvature of the roller 11, the plane 10 progressively changes its inclination to the horizontal, as shown in figure 3, the softer material 18 falls where the inclination is minimal (angle of incidence 20° maximum) and in consequence the component of velocity V25 opposing velocity V is close to zero.

It should be noted that the fan shaped flow that arrives at the inclined plane 10 moving at velocity V now splits into two distinct and separate flows one formed by rigid material 13, which moves in a direction opposite to the direction of velocity V and exits through outlet 14, and one of soft material 15, which moves in the direction V of the inclined plane 10 and is discharged through outlet 16.

It is desired to make it clear that the material 13 contains all the rigid components such as glass, stones, tin cans, aluminium cans, plastic containers etc. and that in this way all the contaminants that would be harmful in the use of municipal refuse to produce compost are eliminated from the flow of material 15; contaminnting materials which are present and easily separable by known means are in the heavy fraction 13.

The invention is also usefully employed when one wants to concentrate the rigid fraction of refuse to facilitate collection from it, for example, of aluminium cans, a separation which would not be possible with presently known and used techniques.

The procedure for separation of a flow of heterogeneous materials into two flows with different physicol characteristics, particularly suitable for treating solid municipal, commercial and/or industrial wastes, and the machine for its implementation are described and illustrated solely as a non-limiting example. Obviously modifications and variations of the present invention are possible in the light of the said indications. It is,

therefore, to be understood that within the framework of the attached claims, the invention may be implemented differently from the specific description.

C L A I M S

1. - Procedure for the separation of a flow of heterogeneous materials into two flows with different physical characteristics, particularly suitable for treating solid municipal, commercial and/or industrial wastes, characterized by what consists in substance of throwing a flow of heterogeneous material against a surface and making it fall to a mobile collector, the trajectories of fall being made different by the dynamics of impact, according to the rigidity of the material, with a consequent division of the original material into two separate flows.

2. - Procedure according to claim 1, characterized by the fact that the flow of material to be treated undergoes three successive phases of treatment.

A first "launch" phase, with a consequent impact against a wall, during which the dynamics of impact differ according to the rigidity of the material, giving rise to different trajectories of fall which

create differences in the points of fall of the different materials and in their velocities of fall.

A second phase in which an appropriately regulated current of air passes across the trajectory of fall, starting from the rigid and towards the soft material, in order to increase the difference between the trajectories of fall for the two types of materials.

A third phase in which, by means of an inclined plane moving in a predetermined direction, the material falling from above it in the aforesaid different trajectories acquires, in part through friction, different speeds and directions of motion, being definitively separated into two perfectly distinct flows nearly free of mutual contamination.

3. - A machine for implementation of the procedure of which in claims 1 and 2, characterized by its essential components:

a device (3) to launch the flow of arriving material to be separated;

a wall (4), variably inclinable, against which the material launched by device (3) strikes;

an outlet (7) for a flow of air that invests the

material (3) along its fall trajectory after its impact against wall (4);

an inclinable plane (10), which perfects separation of the falling materials into two clearly distinct flows, one formed of soft materials (15) and one formed of rigid materials (13).

4. - A machine according to claim 3, characterized by the fact that the accelerator device (3) can be varied in velocity, in this way varying the kinetic energy of the flow of material (20, that the wall (4) can assume different inclinstions to the vertical, and at the same time its distance from the device (3) can be varied, and that the casings (5) and (6) which respectively house parts of the devices, can be mutually displaced to adjust the point of impact of the materials that fall.

5. - A machine according to claim 3, characterized by the fact that through an air inlet (7) a current of air invests, substantially at right angles, the various trajctories of the material (2) falling after impact with the surface (4) and before it reaches the inclined plane (10), there being an outlet filter for the air, with the machine kept

under negative pressure, extracting more air than that injected.

6. - A machine according to claim 3, characterized by the fact that the inclined plane (10) is formed by a sloping conveyor belt, with the possibility of varying the angle of inclination and the velocity, that the draw roller (11) of the belt (10) is of large diameter, whereas the idler (12) is of normal dimensions, that the plane (10) on rotating round the drum (11) progressively changes its angle with the horizontal until the latter becomes zero.

7. - Procedure for separating a flow of heterogeneous materials into two flows with different physical characteristics, particularly suitable for treating solid municipal, commercial and/or industrial wastes, and machine for its implementation according to one or more of the preceding claims, substantially as described and illustrated.

FIG. 1

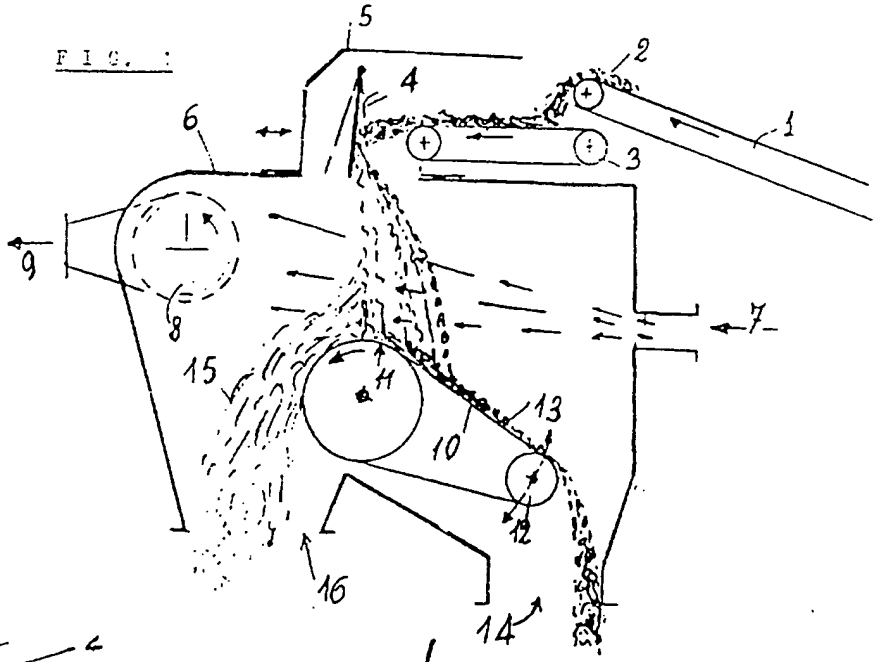

FIG. 2

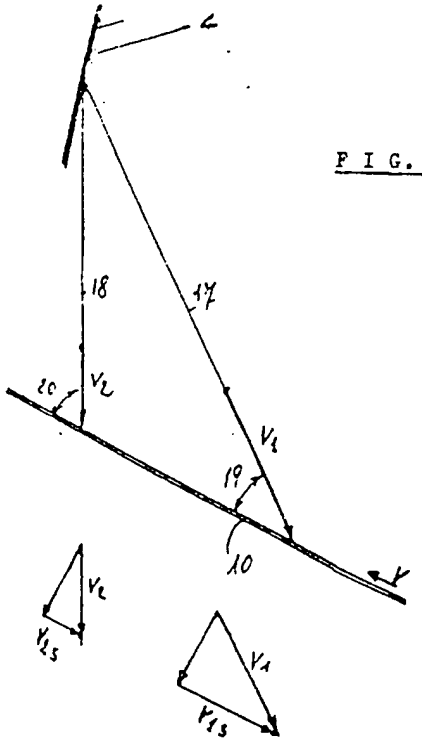

FIG. 3